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(54) WELL TOOL

(72) Henderson, William D.,
U.S.A.

(73) Granted to Otis Engineering Corporation
U.S.A.

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CLASSIFICATION

ABSTRACT

A well packer for sealing with a well casing wall including a tubular mandrel connectible with running and pulling tools and a production tubing string seal assembly, a packer seal assembly on the mandrel having a soft plastic center element, harder plastic end elements, still harder annular support shoes having internal annular recesses to facilitate longitudinal compression and radial expansion, metal back-up shoes and metal shoe supports, an extrusion ring within the support shoes, a lower slip assembly including a one-piece C-shaped slip and an expander wedge for expanding and locking the slip, a lower slip assembly release ring mounted to produce a gap between the lower end of the packer seal assembly and the lower slip assembly to permit the metal back-up shoe to fold downwardly and inwardly to avoid casing obstructions, a releasable lock between the lower end of the mandrel and the lower slip assembly to hold the mandrel during setting and operation of the packer and to release the mandrel when pulling the packer, an upper slip assembly including an expander collet, a support ring within the collet for holding the collet during setting and operation and to release the collet for pulling, a one-piece C-shaped upper slip around the mandrel engageable with the collet, a locking slip segment assembly to lock the upper slip assembly against release with the mandrel, and a setting sleeve releasably engaged with the upper end portion of the mandrel and connected with the upper slip assembly. The packer is set by driving the setting sleeve downwardly relative to the mandrel setting the lower slip, expanding the packer seal assembly, and setting the upper slip. The packer is pulled by an upward force on the mandrel first releasing the upper slip, relaxing the packer seal assembly, and then releasing the lower slip.

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The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A well packer comprising: a tubular mandrel; a longitudinally compressible radially expandible seal assembly on said mandrel for sealing around said mandrel with a casing wall around said packer; deformable upper and lower retainer means on said mandrel at upper and lower ends of said seal assembly for radial expansion against said casing wall to contain said seal assembly at high temperatures and pressures; and ring means at the lower end of said lower retainer means including an outer ring member movable longitudinally away from said lower retainer means to produce an external annular gap around said mandrel below said lower retainer means to receive downward and inward folding of said lower retainer means when pulling said packer to relieve wedging of said lower retainer means against said casing wall.

2. A well packer in accordance with claim 1 including top and bottom slips where said slips are set and released responsive to longitudinal movement of said mandrel, said bottom slip being adapted to set first and release last, and said top slip being adapted to set last and release first.

3. A well packer in accordance with claim 2 where said bottom slips includes means to restrain said slips against setting until a predetermined force is applied.

4. A well packer in accordance with claim 1 where said seal assembly includes a soft center element and sequentially harder elements along said mandrel on opposite sides of said center element.

- 25 -

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WELL TOOL

This invention relates to well tools and more particularly relates to well packers.

The production of wells, especially oil and gas wells, usually requires completion equipment including a well casing in the form of pipe placed in the well and perforated to permit oil and gas production into the well, a production tubing in the form of a pipe string for conducting the oil and gas from the well in the casing, and one or more well packers connected with the tubing for sealing between the tubing and casing. Packers may be of the retrievable type which are installed in a well and may thereafter be pulled back to the surface for servicing and replacing or the packers may be of a permanent type which remain in the well bore and have to be drilled out in the event of re-working a well. Wells, especially deeper wells which are frequently drilled now as oil becomes more difficult to find, provide high temperature and high pressure environments in which packers must function. For example, the temperature may be as high as 600°F at a pressure as high or higher than 5000 psi. Packers which have heretofore been available to satisfy such needs have been quite expensive to manufacture and often have not satisfied the requirements.

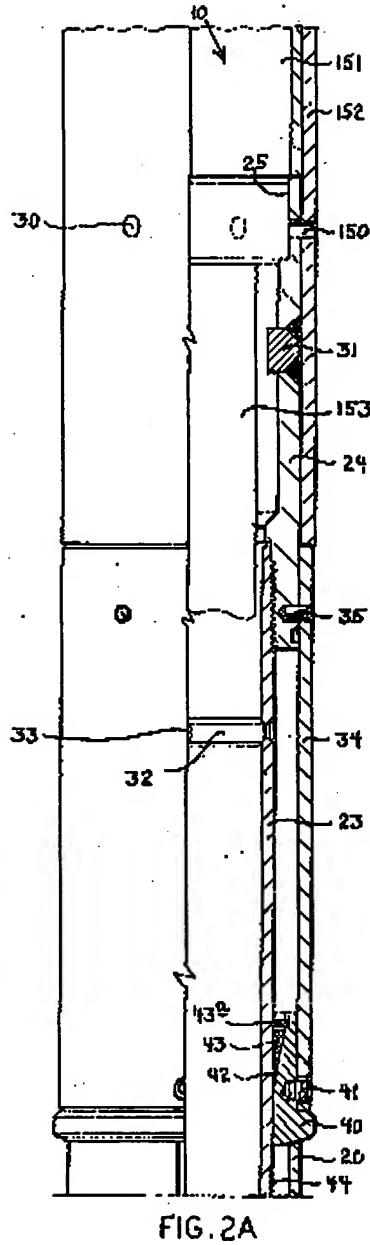
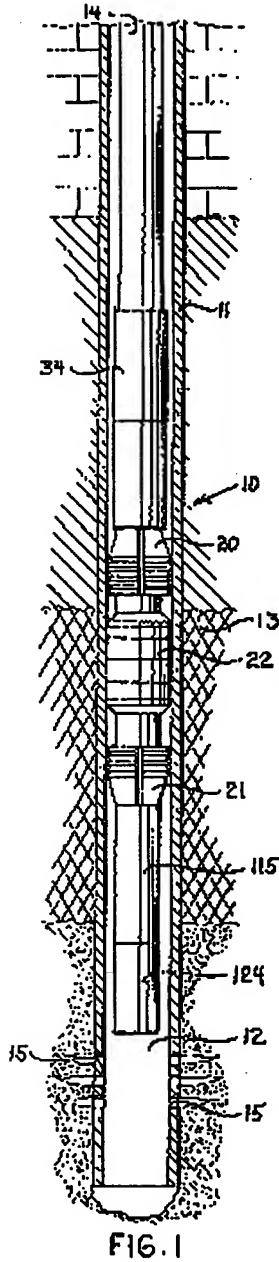
It is therefore a principal object of the present invention to provide a new and improved well tool, more particularly, a new and improved well packer.

It is another object of the present invention to provide



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7-1



WILLIAM D. HENDERSON
Inventor

William D. Henderson
Attorney

1170988

7-3

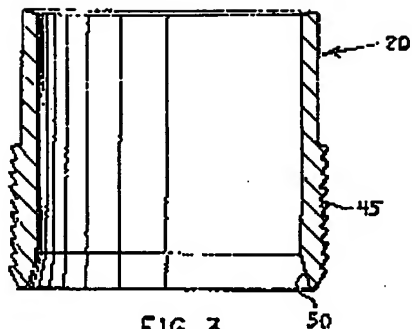


FIG. 3

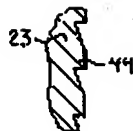


FIG. 6

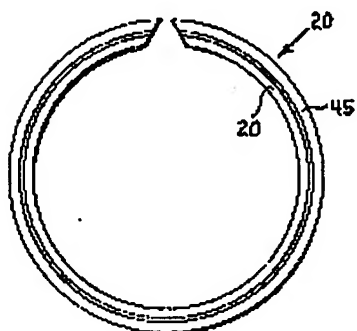


FIG. 4

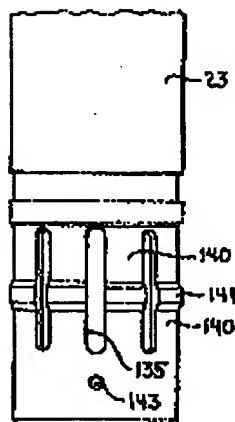


FIG. 7

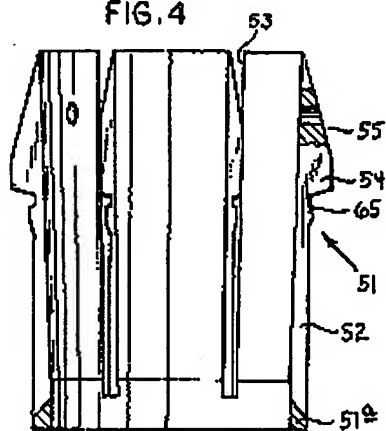


FIG. 5

WILLIAM D. HENDERSON
Inventor

Charles McHenry & Henderson
Attorney

1170988

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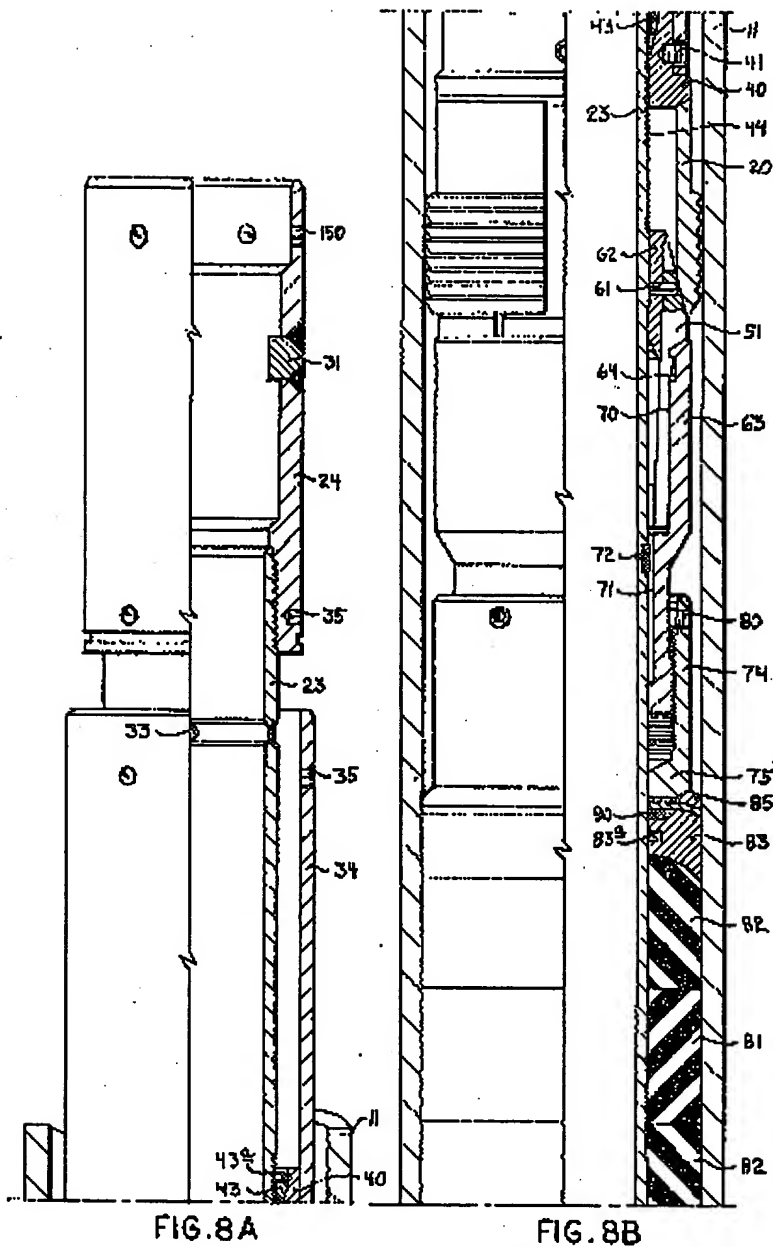


FIG. 8A

FIG. 8B

WILLIAM D. HENDERSON
Inventor

Richard McPherson
Attorney

1170988

7-5

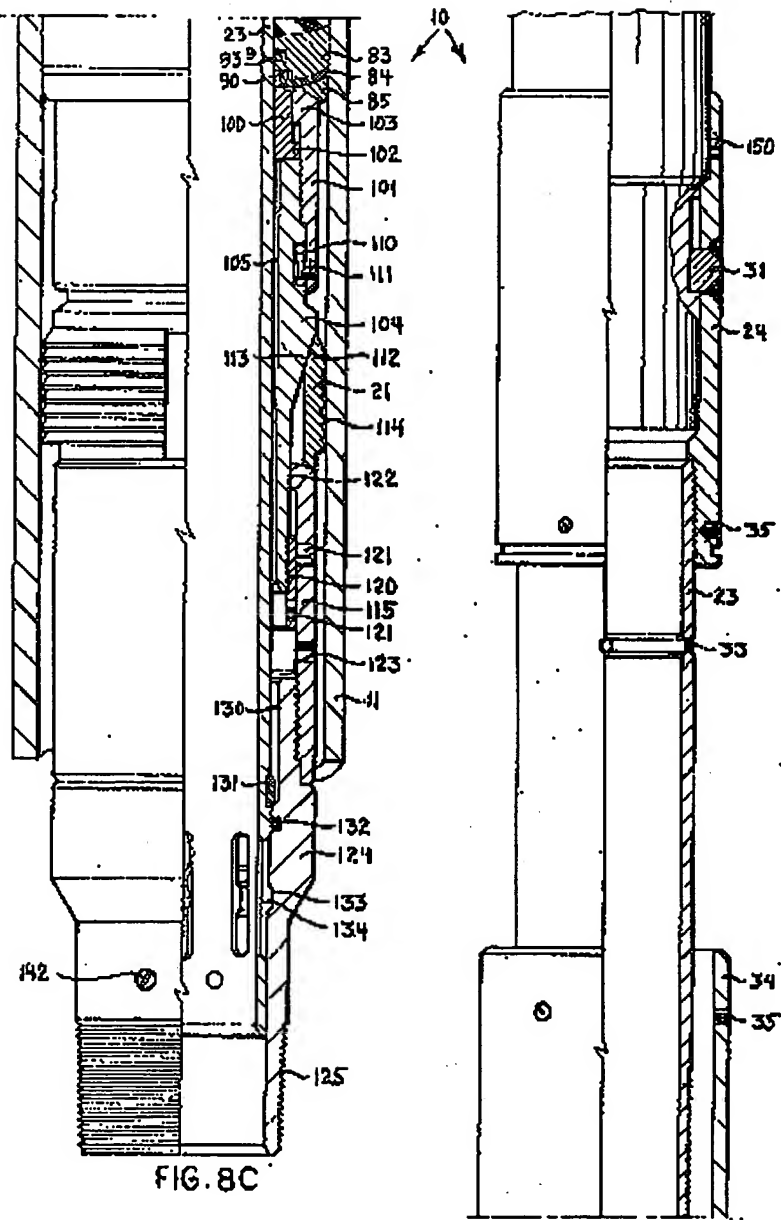


FIG. 9A
 WILLIAM D. HENDERSON
 Inventor
Robert M. King & Harold
 Attorneys

1170988

7-6

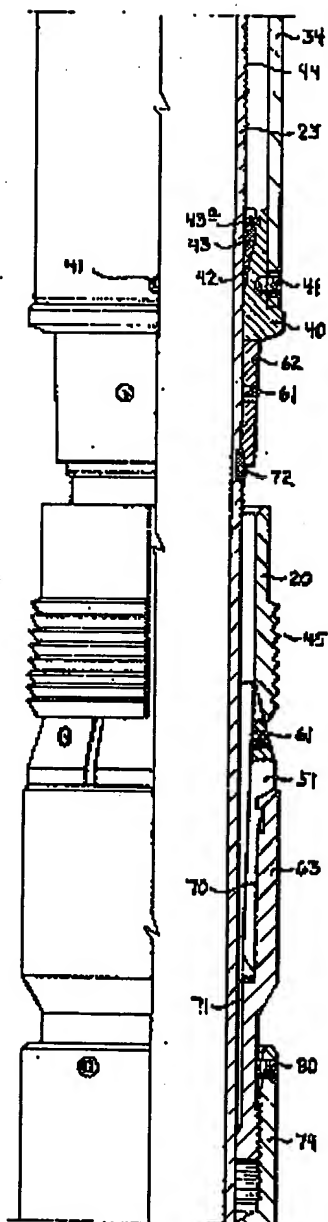


FIG. 9B

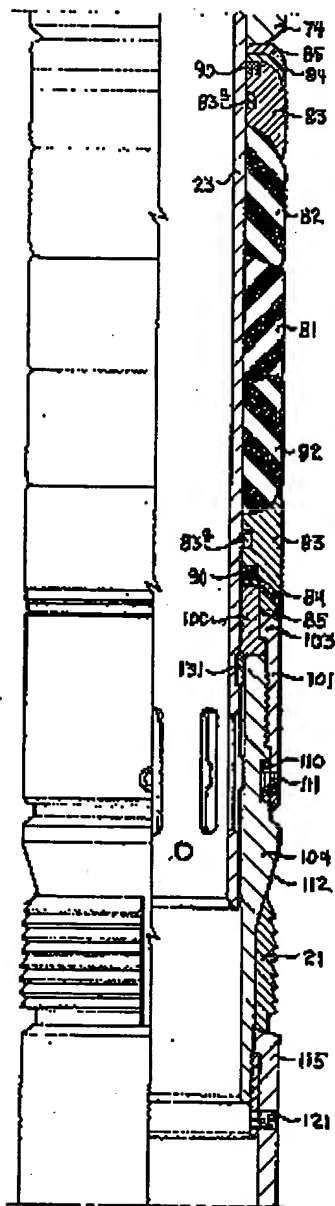


FIG. 9C

WILLIAM D. HENDERSON
Inventor

Robert McHenry & Hubert
Attorney

1170988

7-7

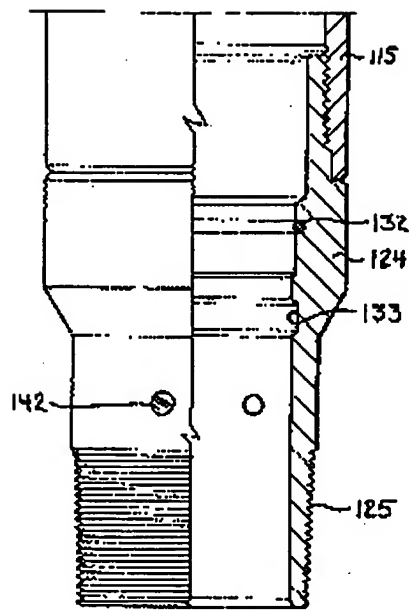


FIG. 9D

WILLIAM D. HENDERSON

Inventor

Charles McHenry & Associates

Attorney

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